

# Concrete pumping

Code of Practice 2005

This Queensland code of practice was preserved as a code of practice under section 284 of the *Work Health and Safety Act 2011*.

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# Introduction

This *Concrete Pumping Code of Practice 2005* is an approved code of practice under section 274 of the *Work Health and Safety Act 2011* (the Act).

An approved code of practice is a practical guide to achieving the standards of health, safety and welfare required under the Act and the *Work Health and Safety Regulation 2011* (the Regulation).

A code of practice applies to anyone who has a duty of care in the circumstances described in the code. In most cases, following an approved code of practice would achieve compliance with the health and safety duties in the Act, in relation to the subject matter of the code. Like regulations, codes of practice deal with particular issues and do not cover all hazards or risks which may arise. The health and safety duties require duty holders to consider all risks associated with work, not only those for which regulations and codes of practice exist.

Codes of practice are admissible in court proceedings under the Act and Regulation. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control and may rely on the code in determining what is reasonably practicable in the circumstances to which the code relates.

Compliance with the Act and Regulation may be achieved by following another method, such as a technical or an industry standard, if it provides an equivalent or higher standard of work health and safety than the code.

An inspector may refer to an approved code of practice when issuing an improvement or prohibition notice.

## ***How is the code organised***

In providing guidance, the word 'should' is used in this Code to indicate a recommended course of action, while 'may' is used to indicate an optional course of action.

This Code also includes various references to provisions of the Act and Regulation which set out the legal requirements. These references are not exhaustive. The words 'must', 'requires' or 'mandatory' indicate that a legal requirement exists and must be complied with.

## **Who has duties?**

A **person conducting a business or undertaking** has the primary duty under the Act to ensure, as far as reasonably practicable, that workers and other persons are not exposed to health and safety risks arising from the business or undertaking.

**Officers**, such as company directors, have a duty to exercise due diligence to ensure that the business or undertaking complies with the Act and Regulation. This includes taking reasonable steps to ensure that the business or undertaking has and uses appropriate resources and processes to provide and maintain a safe work environment.

**Workers** have a duty to take reasonable care for their own health and safety and that they do not adversely affect the health and safety of other persons. Workers must comply with any reasonable instruction and cooperate with any reasonable policy or procedure relating to health and safety at the workplace.

## ***Consulting workers***

Consultation involves sharing of information, giving workers a reasonable opportunity to express views and taking those views into account before making decisions on health and safety matters.

The Act requires that you consult, so far as is reasonably practicable, with workers who carry out work for you who are (or are likely to be) directly affected by a work health and safety matter.

If the workers are represented by a health and safety representative, the consultation must involve that representative.

You must consult your workers when proposing any changes to the work that may affect their health and safety.

### ***Consulting, cooperating and coordinating activities with other duty holders***

The Act requires that you consult, cooperate and coordinate activities with all other persons who have a work health or safety duty in relation to the same matter, so far as is reasonably practicable.

Sometimes you may share responsibility for a health and safety matter with other business operators who are involved in the same activities or who share the same workplace. In these situations, you should exchange information to find out who is doing what and work together in a cooperative and coordinated way so that all risks are eliminated or minimised as far as reasonably practicable.

Further guidance on consultation is available in the *Code of Practice: Work Health and Safety Consultation, Coordination and Cooperation*.

## **1. Managing the risks from concrete pumping**

Under the Act, the risks from concrete pumping, like any other risks, must be controlled using a risk management approach. The object of risk management is to enable you to assess systematically all the factors about an activity involving concrete pumping plant. This approach will help you make a judgement about the associated risks and to put in place appropriate control measures. The risk management approach involves:

- (a) *identifying* concrete pumping plant hazards that pose a risk
- (b) *assessing* the degree of risk created by the plant, environment and work processes
- (c) *determining and implementing* appropriate control measures; and
- (d) *monitoring and reviewing* the effectiveness of the chosen control measures.

It is recommended that the [How to Manage Work Health and Safety Risks Code of Practice](#) be consulted for further information about the risk management process.

## **2. Risks associated with concrete pumping plant**

The risks associated with concrete pumping are many and varied. It may be useful to list risks in terms of their originating hazard. Risk may originate from hazards such as:

- plant and equipment, e.g.
  - concrete placement booms
  - pump gauges
  - concrete pipelines
  - pipe clamps
  - anchor brackets
  - pipe movement
  - delivery hose
  - receiving hopper
- placement of plant and equipment, e.g.
  - proximity to:
    - traffic
    - members of the public
    - powerlines
    - trenches
  - ground stability
- tasks, e.g.
  - concrete delivery
  - pump and boom operation
  - concrete pouring
  - line cleaning

- pump cleaning
- road travel
- by-products, e.g.
  - fumes
  - noise.

This document discusses all of the risks listed above, including appropriate control measures.

### **3. Planning and preparation**

Planning and preparation is the first step in ensuring that work is done safely and in order to be successful must involve consultation with all those engaged in the work.

#### **3.1 Planning by the principal contractor or person in control of the workplace**

When planning for the pumping of concrete the principal contractor or person in control of the workplace should consult with the concrete pumper regarding risks. The principal contractor or person in control of the workplace should ensure:

- (a) the concrete pump is located in the most favourable position to pump concrete, including allowing adequate visual contact for the pump operator with both the pump and the pour area. If this can not be achieved then alternative controls should be implemented (see section 4.3.2)
- (b) a clear, level area of ground with a firm base that is capable of supporting the pump unit and the concrete delivery trucks, is available
- (c) clear access to the pump unit for concrete trucks
- (d) safe and unobstructed access for the general public, to public areas in the vicinity of the pumping unit and the delivery trucks, if the pump unit is set up in the street
- (e) a time schedule is set prior to a major pour commencing, based on a realistic assessment of the time to complete
- (f) an allowance is included for such things as weather, accessibility, volume of concrete, slab & site limitations, equipment back up, restricted work times (local council rules), equipment capacity, concrete pumper's capacity, hose-hand's limitations and the concrete supplier's requirements
- (g) that there is a clearly defined 'pump washout area' complying with environmental protection legislation and local authority requirements
- (h) where compressed air and water lines are supplied on site, that they are positioned to avoid any damage and to comply with the appropriate Australian Standards, and
- (i) there is a method to collect concrete residue and/or all necessary precautions necessary to prevent wash down residue from the clean-up of pumping operations finding its way into stormwater drains (including concrete delivery trucks), particularly where a permanent or semi-permanent set-up has been established on site or where a pump is set-up in a roadway or public place, and ensuring that this residue collection method complies with all Environment Protection Authority requirements.

#### **3.2 Planning by the concrete pumper**

The concrete pumper should consult with the principal contractor or person in control of the workplace in regards to the overall planning for pumping concrete on site. Following this consultation the concrete pumper should consider:

- (a) whether enough workers are available to safely pump concrete, including having a competent worker present at the pump at all times, to operate the emergency shut down system, in case of line failure or other events that require the pump to be shutoff – unless the concrete pump is provided with an automatic system that effectively and reliably shuts down the pump when there is a likelihood of air entering the system.
- (b) the most suitable method of pumping concrete to the pour area
- (c) the capacity and type of pump to be used to complete the job satisfactorily within the required time span
- (d) the location of the pump and access for concrete delivery trucks
- (e) an assessment of any manual tasks that may cause any muscle or ligament strains, or other injuries
- (f) the provision of personal protective equipment and other safety equipment

- (g) the provision of safe access including elimination of trip, slip and fall hazards
- (h) electrical safety, including the location of nearby powerlines and systems of work which comply with electrical safety legislation and the recommendations of any local, relevant compliance requirements
- (i) appropriate instruction manuals accompany the pump unit and/or boom, giving sufficient instructions for operation, maintenance and repairs
- (j) the pump operator is trained and competent with the use of the appropriate manuals and the equipment
- (k) maintenance and repair manuals are kept in a safe place at the registered premises, including a parts catalogue, and are kept up to date with any additional information from the manufacturer, and
- (l) maintenance log books are to be kept on the pump, maintained and be up to date, and are to be made available on request at the workplace.

The concrete pumper should also consult with the concrete delivery company and truck driver prior to the commencement of pumping. Issues to be discussed:

- (a) With the delivery company include:
  - i. control measures chosen and implemented for line blow-out procedures, based on a risk assessment
  - ii. procedures for multiple trucks reversing to the concrete pump.
- (b) With the truck driver include:
  - i. a safe location for the concrete delivery truck driver to stand, when concrete pumping is occurring
  - ii. the need to follow any directions of any allocated traffic controllers/spotters
  - iii. procedures for multiple trucks reversing to the concrete pump.

**NOTE:** Drivers of pre-mix concrete delivery trucks should not be considered workers for pumping operations, unless trained to carry out this function and authorised to act in this capacity by their PCBU.

## **4. Risk controls for concrete pumping plant**

### **4.1 Plant and equipment**

#### **Risk**

The interruption of concrete flow and/or failure of pumping equipment can create potentially dangerous situations. Pressurised concrete escaping from the enclosed pumping system has the potential to strike workers and others, causing injury. Dislodged, unrestrained or burst pipelines and associated equipment also pose a risk to concrete pumping workers, delivery truck drivers and other workers working in and around the designated concrete pumping area. Risks associated with this plant should be identified in terms of pipe construction and pipe restraint.

The risk of mechanical or structural failure of equipment such as concrete placement booms should be identified. Concrete placement booms can have a greater risk of failure due to the cyclic loading of the pulsating pump. The likelihood of fatigue failure of welds is increased in comparison to other plant that does not have this pulsating load. Restraining devices such as pins and circlips also have an increased chance of becoming dislodged. These risks apply to both truck mounted and satellite type booms (building mounted booms).

The information supplied below deals with components of the concrete pumping system. Specific risk controls are recommended for each of these components. The assessment of risk for these hazards remains essentially the same in identifying components and assessing the likelihood of movement or failure.

#### **4.1.1 Concrete placement booms**

##### **Risk**

Structural or mechanical failure of the concrete placing boom

### **Risk control**

To prevent the structural or mechanical failure of concrete placing booms, regular maintenance in accordance with the manufacturer's instructions should be performed. *Australian Standard 2550.15 Cranes – Safe Use – Concrete placing equipment* also provides guidance on the inspection of concrete placing booms.

When inspecting concrete placing booms, consider:

- (a) all functions and their controls for speed(s), smoothness of operation and limits of motion
- (b) all emergency and safety devices
- (c) lubrication of all moving parts, inspection of filter element(s), hydraulic oil, and coolant as specified by the manufacturer, and
- (d) visual inspection of structural components and other critical components such as fasteners, pins, shafts, welds and locking devices.

The erection and dismantling of concrete placement booms should be conducted in accordance with the manufacturer's instructions unless otherwise specified by a professional engineer.

#### **4.1.2 Pump gauges**

##### **Risk**

Gauge damage or malfunction.

##### **Risk control**

Gauges fitted to the concrete pump should be accurate and of a size and style that are easy to read. All instruments should be visually checked and tested on a regular basis and replacements (as recommended by the equipment manufacturer), recorded in the pump's log book.

#### **4.1.3 Concrete pipelines and restraint equipment**

##### **Pipelines**

##### **Risk**

Concrete pipeline failure.

##### **Risk control**

When laying a pipeline, ensure that:

- (a) unnecessary bends are avoided
- (b) horizontal pipelines are adequately supported
- (c) flexible hoses are not at risk of being run over by other plant and equipment being operated in the area
- (d) each section of pipe in a vertical pipeline is supported to avoid extra load on the pipe clamp, in accordance with *AS 2550.15*
- (e) the 90° bend at the base altering the direction of the concrete line from horizontal to vertical is equipped with a leg sitting firmly on the ground sufficient to stop any movement in the vertical line which may snap off the first clamp
- (f) vertical lines are positively secured to the building
- (g) cranes or hoist towers, scaffolding or formwork are not to be used to secure the line, as this method may not be capable of taking the impact load when pumping concrete through the line, and
- (h) all metal pipes and pipeline components are identified and checked in accordance with *AS 2550.15*.

##### **Pipe clamps**

##### **Risk**

Concrete pipe clamp failure.

##### **Risk control**

When using quick release pipe clamps on fixed lines (horizontal or vertical), ensure that:

- (a) the pipe clamps used are able to sustain the maximum concrete pressure applied to the pipeline by the pump

- (b) the locking pins are used and are engaged
- (c) all pipe clamps are regularly inspected by a competent person for signs of wear and fatigue
- (d) pipe clamps which show any deformation or damage are immediately replaced
- (e) pipe clamps that are manufactured with no provision for locking pins are not used, and
- (f) clamps are locked as per the manufacturer's instructions and are not locked by hammering the quick release clamp lever, or by other methods which may cause fatigue of the clamp's metal.



Figure 1. High pressure pipe clamp.

### **Anchor brackets**

#### **Risk**

Concrete pipeline failure.

#### **Risk control**

When inserting anchor brackets on the concrete delivery pipe the concrete pumper should ensure that:

- (a) anchor brackets and tie-downs are used to adequately secure the system, at intervals of no more than three metres apart<sup>1</sup>, unless otherwise specified by a competent person
- (b) the number of bolts used to secure an anchor bracket should be in accordance with AS 2550 Set, the pump manufacturer's specifications or in accordance with advice from a professional engineer
- (c) where friction type 'drill-in' anchors are used, these are of the high-load slip, torque controlled type and have a factor of safety of 3 to 1 based on their failure load
- (d) chemical anchors are pull out load tested to 125% of their working load and have a factor of safety of 3 to 1 based on their failure load, and
- (e) when securing pipes overhead (i.e. so that the bracket anchors are loaded in pure tension), 'through bolts' that extend through the concrete slab are preferable to drill-in type anchors. If drill-in type anchors are used in this application they should all be pull out load tested to 125% of their working load.

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<sup>1</sup> It is acknowledged that it may not be practicable in all situations to install anchor brackets every 3 metres. If not practicable a risk assessment should be conducted to ensure that risk of pipe movement is adequately controlled.



Figure 2. One method of anchoring pipe.

### **Pipe movement**

#### **Risk**

Excessive pipeline movement.

#### **Risk control**

Where excessive pipe movement occurs in temporary laid lines due to the surging action of the pump, to:

- (a) use extra anchorage methods to restrict the line movement, especially at bends and elbows, or
- (b) install a short wire-braided high pressure rubber hose between the concrete pump and pipelines in accordance the manufacturer's recommendations.

### **4.1.4 Hose whip**

#### **Risk**

“Hose whip” is the term used to describe uncontrolled and rapid motion of the flexible rubber hose on the end of a concrete placement boom or other concrete delivery line. Persons can be injured by being struck directly by the whipping hose itself, or being knocked over and hitting the ground or an object, or being hit by ejected material.

Hose whip can occur during the concrete pumping operation itself or when the line is being cleaned out. In either case, hose whip can be especially violent when air enters the line and becomes pressurised due to an obstruction further down the line, and the obstruction becomes dislodged.

#### **Risk control**

The likelihood of hose whip can be greatly reduced by the selection of suitable plant and safe systems of work. While the risk of hose whip can be reduced, additional precautions need to be taken to reduce the likelihood of injury.

To minimise the likelihood of injury from hose whip:

- (a) Only pump concrete that is a pumpable mix as specified by the concrete supplier. Other types of concrete can block the line and cause hose whip.
- (b) Do not let the concrete solidify in the line as this will cause blockages. The concrete needs to remain in its plastic state.
- (c) Use well trained, competent operators to pump concrete (See Figure 3).
- (d) Start the pump up slowly to reduce the likelihood of hose whip.
- (e) Never use a rubber delivery hose with metal fittings attached to the free end.
- (f) Persons not involved in the concrete pour should be excluded from the delivery hose area.
- (g) Never stretch the delivery hose if it doesn't reach the pouring location (see Figure 4).
- (h) The delivery hose on a boom pump should hang close to vertical and only be guided by the line hand. If the boom is not long enough to reach the concrete pour area, a longer boom should be used or the concrete pump should be moved closer to the job.
- (i) Workers should always wear appropriate personal protective equipment, including hard hats.
- (j) Good housekeeping needs to be maintained around the work area to reduce the likelihood of tripping.
- (k) Do not let more hose hang from the boom than that allowed by the placement boom manufacturer. Normally only a maximum of three or four metres of 125 mm diameter hose can be suspended from the boom.
- (l) Do not allow concrete to drop out of the hose when pumping is stopped, as this can allow air to enter the system. The hose can be folded over to prevent concrete dropping out.
- (m) Always ensure the line hand has an adequate sized area to stand on (the width of the working surface should be 450 mm or greater). The line hand should not stand on block walls or next to unprotected edges. (See Figure 5.)



Figure 3 – Line hand guiding hose and signalling to pump operator.



Figure 4 – Workers stretching hose for additional reach. This is an unsafe work practice.

- (n) Monitor the level of concrete in the hopper to avoid air getting sucked into the pump system. Ensure a separate person to the line hand is in position to view the hopper (normally the pump operator), unless there is a reliable automatic shut off device fitted.
- (o) Make sure safe work procedures are adopted for clearing blockages.
- (p) Preferably clean out the concrete line with water instead of air.
- (q) When there is no other option but to clean the pump line out with air, secure the end of the steel line and have an exclusion zone. All reducers and rubber hose must be removed from the end of the delivery line. A ball catcher should be fitted to the end of the steel pipe which will contain the blow out plug (i.e. sponge) as it is ejected from the line.



Figure 5 – Pouring concrete into column form. Good access provided.

## 4.2 Placement of plant and equipment

### 4.2.1 Setting-up on site

#### Risk

There are numerous risks associated with the setting-up of concrete placing equipment, including concrete pumping booms tipping over and the risk of workers being crushed or run over by the mobile pump or concrete truck. Consultation regarding the risks involved with the set-up of concrete placing equipment should occur between the principal contractor or person in control of the workplace and the concrete pumper.

#### Risk control

When setting-up a concrete pump the area should be level, capable of supporting the load and free of obstructions, with careful attention paid to the following.

- (a) Particular care and precautions should be taken when a concrete pump is used in the vicinity of an excavation, as the weight of the concrete pump and the load can affect the stability of the excavation wall and cause the excavation wall to collapse, which may lead to the concrete pump overturning. The pump should not be positioned over or adjacent to:
  - i. previously disturbed ground that has been back-filled,
  - ii. excavations, trenches or holes in the ground,
  - iii. cellars, basements or pits, or
  - iv. inadequately compacted or soft ground.
- (b) If the ground is not firm or is near an excavation, the operator should immediately refer the matter to the principal contractor for re-location to a more stable location.
- (c) That the pump unit is set up level, and if this cannot be achieved ensure that the incline or angle of the machine does not exceed the manufacturers recommendations (refer to operating instruction manual).
- (d) If outriggers are required:
  - i. supply adequate sole plates for the purpose of packing the base plate,
  - ii. ensure the outriggers pads are clear of excavations, soft or filled ground, or other obstacles liable to interfere with the safe operation of the machine,
  - iii. ensure that the sole plate material, if timber is 'pigstyed' and are of sufficient bearing area to support the machine, and
  - iv. ensure the outriggers do not subside, by making regular checks to ensure stability.
- (e) Unauthorised persons should be kept away from the machine and associated equipment.
- (f) Persons working in the concrete pumping exclusion zone should wear high visibility vests.
- (g) The exclusion zone should be marked with signage requiring persons to wear high visibility vests.
- (h) The area should be clearly marked and made safe from other traffic.
- (i) Set-up areas should be provided with clear access and adequate lighting at all times, during operation.

- (j) Where operation of the plant is required at night or low light conditions, artificial lighting should be provided.
- (k) A sign is posted clearly stating that the area is for authorised persons either, for example 'Danger – Concrete Pumping Area – Authorised Persons only'.

#### **4.2.2 Setting-up near powerlines or electrical equipment**

##### **Risk**

Contact with overhead power lines can pose a major risk when pumping concrete. Before setting-up concrete pumping equipment in the vicinity of overhead powerlines, consultation regarding risk should occur between the principal contractor or person in control of the workplace and concrete pumper. Where it is claimed that power lines have been de-energised, written documentation from the relevant power supply organisation should be available on site.

The *Electrical Safety Regulation 2002* regulates work around overhead power lines. Practical advice on such work is also provided in the *Electrical Safety Code of Practice 2010 - Working Near Exposed Live Parts*. One of the requirements is that workers and plant should maintain an 'exclusion zone' of three metres around live overhead power lines of up to 132kV. Powerlines on poles are usually less than this voltage.

Greater 'exclusion zones' apply to high voltage lines (six and eight metres depending on the voltage). In certain limited situations there may be exceptions to this – see the *Electrical Safety Regulation 2002* and the *Electrical Safety Code of Practice 2010 – Working Near Exposed Live Parts* for details.

When operating plant near power lines a number of factors must be considered when implementing systems to maintain the 'exclusion zone' from overhead power lines. These include:

- (a) identifying the minimum clearance distance from the closest part of the concrete placement boom to the power line, the 'exclusion zone'
- (b) allowing for sway and sag of the overhead lines (Sway is usually caused by wind and sag occurs when the temperature of the line fluctuates)
- (c) ensuring that persons, plant and vehicles stay outside the 'exclusion zone' at all times, and
- (d) nominating a 'safety observer' when the crane or plant could enter into the 'exclusion zone' (where this is required by the *Electrical Safety Code of Practice 2010 – Working Near Exposed Live Parts*).

The exclusion zones for Queensland Rail power lines and those of some power authorities may differ. It is the responsibility of the principal contractor or person in control of the workplace to check with the person in control of the overhead electric line.

There are a number of devices available that either assist in preventing contact with power lines, or reduce the degree of risk in the event of contact. Such devices include the following.

- (a) The use of 'tiger tails' on power lines act as a visual aid that assists in preventing contact by highlighting the location of the power line. Only low voltage lines (under 1000 volts) can be continuously covered with tiger tails, which leaves the higher lines on power poles (usually at least 11,000 volts) exposed. *Note: tiger tails do not insulate the wires and therefore the 'exclusion zone' must be maintained.*
- (b) Limiting or warning devices to assist in preventing the pump boom from entering the exclusion zone. If a limiting or warning device is used, the system should be designed to 'fail safe' or should at least meet category 4 reliability in accordance with *AS 4024.1 Series – Safety of Machinery* or *BS EN 954-1 Safety of Machinery – Safety Related Parts of Control Systems – General Principles for Design*.
- (c) Earthing of concrete placing booms should be in accordance with the *Electrical Safety Code of Practice 2010 – Working Near Exposed Live Parts*.

**Irrespective of whether safety devices are being used, the 'exclusion zone' must not be encroached.**

Unloading and setting-up of concrete pumping pipes also poses a risk of contact with overhead powerlines. Pipes should be kept parallel to the ground when setting-up near overhead powerlines. An observer can be used to ensure that concrete booms do not come into proximity to powerlines.

Further information may be obtained in the *Electrical Safety Regulation 2002* and the *Electrical Safety Code of Practice 2010 – Working Near Exposed Live Parts* or on the Electrical Safety Office website [www.eso.qld.gov.au](http://www.eso.qld.gov.au).

#### **4.2.3 Setting-up in a public place**

Before setting-up a concrete pump in a street, roadway or public place consultation should occur regarding relevant risks between the principal contractor or person in control of the workplace and the concrete pumper. Careful attention should be given to the following.

- (a) Approvals are usually required from local councils and, these should be examined by the concrete pumper.
- (b) The public should be directed to an alternative footpath, and protective screens erected or fitted around the pump area to prevent concrete being splashed on the public.
- (c) Lane closures and other operations which require the erection of appropriate barricades and signs should comply with the requirements of Main Roads, Local Government Authorities and any relevant Building or Local Acts.

#### **4.2.4 Traffic control**

The person in control of the relevant workplace area will provide or arrange for adequate traffic control, in consultation with the concrete pumper.

### **4.3 Tasks**

#### **4.3.1 Concrete delivery**

##### **Risk**

Concrete delivery involves the delivery of concrete from the delivery truck to the concrete pump hopper. In this operation one or more concrete trucks are reversed up to the concrete hopper to deliver concrete. This activity poses risks to the concrete delivery truck driver, the concrete pump operator, the allocated traffic spotter, other workers working in and around the concrete pumping exclusion zone and members of the public.

The risks from this phase of delivery include:

- being hit or run over by a delivery truck
- entrapment between the delivery truck and hopper or between delivery trucks
- being struck by concrete whilst delivering concrete to the hopper, due to equipment failure such as a burst line
- entanglement, crushing and amputation from the concrete hopper, and
- being struck by ejected pipes from the concrete pump due to clamp failures, whilst discharging concrete into the hopper.

##### **Risk control**

When delivering concrete, the following should be ensured.

- (a) Concrete delivery trucks should have clear and safe access to approach and leave the receiving hopper of the pump.
- (b) If more than one concrete delivery truck is required to approach the receiving hopper at any one time, the person in control of the relevant workplace area should ensure a spotter or traffic controller is on hand to safely direct the movement of the trucks, considering the safety of each worker in the area.
- (c) Concrete delivery trucks should not reverse into the exclusion zone if they cannot see the nominated person for directing the truck (the spotter). The vehicle should be stopped immediately when the driver loses sight of the nominated person directing the truck.
- (d) If more than one concrete delivery truck is required to approach the receiving hopper at any one time the person in control of the relevant workplace area should ensure:
  - i. a spotter or traffic controller is on hand to safely direct the movement of the trucks, and

- ii. there is adequate room for the concrete delivery truck driver to operate the concrete truck safely and in the event of an emergency have clear access to operate the concrete pump emergency shutdown device.
- (e) No person should stand between the reversing concrete delivery truck and the hopper.
- (f) The concrete chute on concrete trucks should only be moved when the truck is stationary. It is preferable for the truck driver to perform this task. If another worker carries out the task the permission of the driver should be obtained.
- (g) The concrete receiving hopper should be at a height that allows a gravity flow of concrete into the hopper.
- (h) Additional ramping may be required for the concrete delivery truck where low slump concrete is to be used. Where ramps are used they should be specifically designed to:
  - i. ensure the truck cannot back off the ramps,
  - ii. ensure the truck remains stable, and
  - iii. have a non-slip surface.
- (i) All concrete delivery trucks should be fitted with flashing hazard lights that are activated when the truck is in reverse.
- (j) All concrete delivery trucks should be fitted with audible reversing devices.

**When delivering concrete to the pump hopper the following should be ensured:**

- (a) The receiving hopper of the concrete pump should be positioned so that it can receive a concrete flow readily from the discharge chute of a concrete delivery truck.
- (b) A grate is to be provided to prevent access to dangerous moving parts such as agitator mechanisms and valve gear (“S – tube” or “rock valve”). Hopper grates designed for opening are to be fitted with an interlock system that de-activates **both** the paddles and the valve gear. This system is to ensure that there is no energy in the system that can cause movement of the agitator mechanism or valve gear after the interlock switch is activated (i.e. from remaining hydraulic pressure in the accumulator).
- (c) The emergency stop button should be accessible by the concrete pump operator and the concrete delivery truck driver.
- (d) The grate should be constructed of parallel bars which are spaced so that it is not possible for a person’s hand to become trapped (this spacing should not exceed 75mm).
- (e) The distance from the top of the grate to any moving parts should be at least 100mm.

**4.3.2 Pump and boom operation**

**Risk**

Inexperienced or untrained operators pose a risk of unsafe operation.

**Risk control**

Concrete pump and boom operators should be competent to safely operate relevant equipment. Competency is achieved through training and supervision and should be assessed by testing both theoretical knowledge and physical operation of the machinery.

Pump and boom operators should:

- (a) be familiar with manufacturer’s advice and information contained within manuals and other documents, including hydraulic pressure relief settings and maximum rated concrete pressure
- (b) operate the plant in line with the advice and information of the manufacturer
- (c) carry out the daily maintenance inspection, visual inspection of the pipeline and other pre-operational inspections in accordance with the plant operator’s manual, before pumping commences
- (d) always attend to equipment, or arrange for a alternative competent person to attend if required to work away from the equipment
- (e) pump concrete only when the hopper grate is in the closed position
- (f) ensure pump flow rates match discharge rates of concrete delivery trucks
- (g) be able to maintain a volume of concrete in the concrete pump hopper at levels that will not allow air into the pump .Include specifics of how this will be achieved in the safe work method statement (e.g. automatic shut-off if level of concrete in hopper falls too low; or additional competent person stationed at hopper to stop the pump)

- (h) follow the directions of the hose-hand, and
- (i) ensure a system of communication is maintained with the hose-hand.

### 4.3.3 Concrete pouring

#### Risk

The concrete pour involves the pouring of concrete through the delivery hose connected to the concrete pump, to the concrete pour area. In this operation there may be a risk of concrete lines bursting, lines becoming unrestrained and pipe clamps being dislodged. Damage to delivery hose or the inappropriate selection of the delivery hose may also cause the discharge of concrete under pressure.

#### Risk control

- (a) The rubber delivery hose should always be checked for damage prior to being fitted.
- (b) Where the delivery hose is positioned over or above any working or public area, it should be fitted with a suitable stop at the outlet end.
- (c) Care should be taken to avoid damage to the hose during use.
- (d) Ensure the delivery hose fitting on a boom pump is secured in position by a safety chain, sling or other retaining device in accordance with *AS 1418.15 Cranes (including hoists and winches) – Concrete placing equipment*.
- (e) Always use a delivery hose that has a pressure rating to accommodate the pumping concrete pressure. Steel re-enforced delivery hose should be used with high pressure pumps such as those used on high-rise 'satellite' booms. As a guide, delivery hose that is not re-enforced (sometimes called 'rag' or 'fabric' hose) should not be used on piston type pumps, unless the pumping pressure is within the maximum allowable hose pressure rating specified by the manufacturer. Where there is any doubt about the ability of the hose to withstand concrete pressures, written verification from the hose manufacturer should be obtained.
- (f) Additional hose added to the end of a concrete placement boom may cause structural failure of the boom, when the hose hangs from the end of the boom and concrete is pumped through it. Documentation should be available on site that shows the maximum size and length of hose that may be suspended, as stated by the boom manufacturer.
- (g) Reducers should be used as per the manufacturer's recommendations to avoid overload of the delivery hose or other parts of the unit.
- (h) The hose-hand should wear eye protection complying with *AS 1336 Recommended practices for occupational eye protection*.

### 4.3.4 Line cleaning (on site)

#### Risk

Line cleaning is usually performed with either high pressure water or air, to ensure the dislodgement of residual concrete located in the pipeline. Dislodged concrete can act as a high-velocity projectile, potentially striking both workers doing cleaning and those nearby (including members of the public). To avoid hose whip, all reducers and rubber hose must be removed from the end of the delivery line.

This matter should be discussed by the principal contractor or person in control of the workplace and the concrete pumper.

#### Risk control

A risk assessment should be performed and documented so that adequate controls are implemented to control the risks associated with line cleaning.

When performing line cleaning the following safety precautions should be followed:

- (a) Only experienced and trained pumping personnel should carryout line cleaning.
- (b) Cleaning should be conducted in accordance with the manufacturer's instructions and PCBU's or other duty holder's procedures.
- (c) Water should be used for cleaning in preference to air to minimise the risk of projectiles.
- (d) There should always be a connection to atmosphere (air relief valve) as well as the air entry point to the pipeline, which will allow the system to be depressurised before removing any pipeline

(never attempt to take a line apart to clean out a blockage or to dismantle it until after the pressure has been relieved).

- (e) No pipeline connection or fitting should be disconnected unless it has been established that the pipeline is free of internal pressure.
- (f) The pump operator is to remain at the pump controls while the pipeline is pressurised.
- (g) Always remove the rubber delivery hose at the END of the pipeline, so that the hose can not whip around dangerously should the line be blown out.
- (h) All parts of the pipeline should be secured to prevent movement during purging.
- (i) A positive catchment device or properly designed receptacle should be attached to the discharge end of the pipeline to safely catch the cleaning device, while still allowing concrete to flow.
- (j) If using a properly designed receptacle, such as a concrete truck bowl, concrete lines should be adequately restrained from movement. Restraint by attachment to the concrete truck's ladder is not an adequate control.
- (k) Keep all workers away from the discharge end while the concrete is under pressure.
- (l) Ensure all workers involved wear adequate personal protective equipment.

#### **4.3.5 Pump cleaning (on site)**

##### **Risk**

Entanglement, crushing and amputation hazards exist in a concrete hopper and pumping device and can injure workers who stand in or place parts of their body in hoppers. Workers should avoid placing any part of their body within the hopper.

This matter should be discussed by the principal contractor or person in control of the workplace and the concrete pumper.

##### **Risk control**

- (a) A physical barrier to prevent a person contacting moving parts in a hopper should be fitted and maintained at all times during operation.
- (b) Where cleaning or dislodgement of material requires a worker to enter the hopper, the equipment must be shut down and any accumulated hydraulic or air pressures exhausted that may allow the elements to move or rotate, even with the engine stopped.
- (c) Cleaning should only be done when there is another person in the immediate vicinity to provide assistance if required.
- (d) Workers should receive adequate instruction, training and where required supervision, in cleaning a concrete hopper.

#### **4.3.6 Preparation for road travel**

##### **Risk**

Unsecured equipment poses a risk to concrete delivery truck drivers, pedestrians and fellow motorists. Over time unsecured equipment may be subject to increased wear which may lead to failure.

##### **Risk control**

The manufacturer's instruction must always be followed, particularly where the following items are appropriate.

- (a) **Outriggers** (whether hydraulic or manual), must be secured with a locking device specified by the manufacturer and stowed in a travelling position to ensure that there is no lateral movement.
- (b) **Loose components** (such as pipes, couplings and tools etc), must be stowed in appropriate storage areas in accordance with manufacturer or other any relevant published guidelines for the safe carriage of loads on road vehicles (e.g. Load Restraint Guide (2003) ISBN 0664 329319).
- (c) Disengage all **drives to hydraulic pumps** (for operating the concrete pump), boom and/or outriggers, and put the controls in the OFF position.
- (d) **Boom restraint** should be in accordance with any instructions by the manufacturer and should ensure there is no unintended movement of the boom.
- (e) **Air operated devices** for 'Engage' and 'Disengage' of 'power takeoff' (PTO) drives must be of an approved type and brand, and must have a positive feel for the 'In' and 'Out' position with a warning light when engaged (if able to be operated independently).

## 4.4 By-products

### 4.4.1 Noise

#### Risk

Excessive noise at the workplace can cause industrial deafness, also known as noise-induced hearing loss. The Code of Practice on *Managing Noise and Preventing Hearing Loss at Work* gives detailed information on the assessment of noise in the workplace. It is recommended that this standard be read in conjunction with the *Concrete Pumping Code of Practice*. Before pumping equipment is set-up consultation should be undertaken between the principal contractor or person in control of the workplace and the concrete pumper, regarding the risk of excessive noise.

#### Risk control

- (a) Noise levels from machinery or equipment during pumping operations should not be a risk to hearing or health.
- (b) Suitable hearing protection equipment, and training in its maintenance and use, should be provided to the operators of the concrete pump and other associated equipment if the noise is in excess of the noise exposure limits.

The Regulation prescribes maximum levels for excessive noise in the workplace. These requirements must be complied with by law and as such it is highly recommended that this part of the regulation be read in conjunction with the *Concrete Pumping Code of Practice*.

### 4.4.2 Fumes

#### Risk

All fumes should be identified and assessed for risk. Of most concern are exhaust gases from the concrete delivery truck and any internal combustion engines. Carbon monoxide is a hazardous chemical and in large concentrations can cause permanent illness and death. An assessment of the truck, concrete pump and associated plant location is necessary, to consider the likelihood of gas build-up.

This matter should be discussed by the principal contractor or person in control of the workplace and the concrete pumper.

The Regulation states requirements when exposing persons to hazardous chemicals, such as exhaust gas fumes. The PCBU must follow these requirements.

#### Risk control

If possible place the truck in a position that will eliminate or reduce the build-up of exhaust gas. If it is necessary to place the truck in an enclosed area ensure that:

- (a) an adequate level of ventilation is maintained to prevent the build-up of hazardous exhaust gases, or
- (b) exhaust gases are vented to open air.

## 5. Inspection and maintenance

### 5.1 General

Appropriate 'planned inspections' and 'preventative maintenance programs' are essential for safety and efficiency in the operation of concrete pumps and booms, and should be carried out in accordance with the manufacturer's recommendations, and *AS 2550.15*. These inspections and routine maintenance should be carried out:

- (a) daily before commencement of work
- (b) weekly
- (c) monthly
- (d) three monthly
- (e) yearly, and
- (f) six yearly strip downs.

## 5.2 Compliance plates and certification

All equipment associated with concrete pumping must have fixed compliance plates, and/or appropriate certification for their use, e.g.

- (a) cab and chassis – by the state transport authority in which the unit is registered, with a fixed motor vehicle modification plate showing the appropriate modification codes
- (b) placing boom and outriggers:
  - (i) by the manufacturer, with a fixed plate showing date of manufacture, serial number, maximum recommended working pressure, maximum recommended length of end (or drop hose), recommended maximum size of delivery pipe/hose, etc. in accordance with *AS 1418.15 Cranes (including hoists and winches) – Concrete placing equipment*
  - (ii) following each six year strip down, by a professional engineer whose area of competence includes the type of work being undertaken, with a fixed plate setting out the details of the annual inspection and the six year strip down and inspection dates, in accordance with *AS 2550.15 Cranes – safe use – Concrete placing equipment*
- (c) concrete pump – by the manufacturer, with a fixed plate showing date of manufacture and serial number
- (d) maximum recommended working pressures for hydraulics and concrete etc, in accordance with *AS 1418.15 Cranes (including hoists and winches) – Concrete placing equipment*, and
- (e) Over Length and Overweight Permits must be obtained, kept current, and in the vehicle.

Any pump, boom, prime mover and/or associated equipment not having such a compliance plate or permit, should be removed from service immediately, until such certification is effected.

## 5.3 Pre-operational inspections

- (a) Before the start of each work period, all concrete pumping/placing equipment should be given a visual inspection and function test – in accordance with the manufacturer's instructions and recommendations, and *AS 2550.15 Cranes – safe use – Concrete placing equipment*.
- (b) Any repairs or replacements should be in accordance with the manufacturer's recommendations and only carried out by trained and competent personnel.
- (c) Written records should be kept of maintenance and repair work performed on concrete pumping/placing equipment.

## 5.4 Routine maintenance inspections

- (a) The owner should establish an appropriate program of weekly, monthly and quarterly preventative maintenance inspections of all equipment in accordance with the manufacturer's recommendations and *AS 2550.15 Cranes – safe use – Concrete placing equipment*, which is based on the equipment's working environment and the severity of use of the equipment.
- (b) Details of these inspections are to be kept in the appropriate log book, and a copy kept in the unit.

## 5.5 Annual inspections

All concrete placing booms, pumps and all other associated equipment, should be inspected once a year by an assessor, for the suitability of continued service, in accordance with the manufacturers specifications, and *AS 2550.15 Cranes – safe use – Concrete placing equipment*.

## 5.6 Assessment for service and continued use

All items of concrete placing equipment should also be additionally subjected to a major inspection for assessment of continued service of the concrete placing equipment in accordance with *AS 2550.15 Cranes – safe use – Concrete placing equipment*.

These inspections should include a strip down of all high stress areas, including the boom, slew ring and outriggers.

The inspection should be conducted by a professional engineer, with competence in this work, to assess the suitability of the equipment for continued service until the next major inspection. All inspections should be noted in the appropriate log book.

All concrete placing equipment should be assessed for service and continued use six years after the date of manufacture and at each six year period thereafter.

### **5.7 Inspection report**

If repairs/replacements are required (as assessed in accordance with the manufacturer's recommendations and/or the requirements of *AS 2550.15 Cranes – safe use – Concrete placing equipment*), then the plant owner should ensure that a record of the repair/replacement action required, together with the reason, is recorded in the log book. If no action is taken, or the equipment continues to fail to meet the assessment criteria, then the inspector may order that the equipment be removed from service immediately.

### **5.8 Welding and other repairs**

Only a welder or service provider holding the appropriate qualifications, and where possible in possession of the manufacturer's current specifications may perform welding or repair work on the concrete pump or any associated equipment (including the placing boom, the outrigger system or any other stressed structural component that is related to the overall equipment stability or structural integrity).

### **5.9 Reporting defects**

- (a) A pump operator should report defects immediately.
- (b) If a defect is considered to be a hazard to safety, pumping operations should be stopped until the defect is repaired.
- (c) The details of reported defects and subsequent action taken should be entered into a log book.

### **5.10 Log books and inspection record sheets**

- (a) Instruction manuals should accompany the pump unit and/or boom, which give sufficient instructions for operation, maintenance and repairs.
- (b) Maintenance and repair manuals are to be kept in a safe place at the registered premises, and should include a parts catalogue.
- (c) The operator should be familiar with the contents of the instruction manual which should be available at the site of operation.
- (d) All manuals should be kept up-to-date with any additional information from the manufacturer.
- (e) Maintenance log books are to be kept up-to-date, on the pump, and be available on request at the workplace.
- (f) All log books and inspection record sheets are to show complete details of all inspections, tests, repairs, replacements and modifications carried out on equipment, in accordance with *AS 2550.15 Cranes – safe use – Concrete placing equipment*.
- (g) Evidence that the pump and associated equipment has been inspected and certified as 'suitable for continued service' (i.e. in a safe working condition), should accompany the unit, and be made available to the principal contractor or person in control of the workplace for inspection (on request), before the unit is allowed to operate on site.
- (h) Similarly, up-to-date log books & inspection record sheets should accompany the unit and also be available for inspection by the principal contractor or person in control of the workplace.

### **5.11 Warning and safety signs**

Ensure that all warning and safety signs/stickers are in good condition, legible and positioned on all equipment (after being inspected and found to be serviceable), in accordance with *AS 2550.15 Cranes – safe use – Concrete placing equipment*.

### **5.12 Pipe testing, identification and marking**

- (a) Pipe wall thickness should be tested in accordance with *AS 2550.15 Cranes – safe use – Concrete placing equipment*.
- (b) Ultrasonic testing may not be appropriate for a twin wall pipeline. Other suitable testing methods should be adopted such as the use of thickness testing callipers, increased inspection and increased monitoring of use, in terms of volume and type of concrete pumped.
- (c) Piping with a wall thickness less than the recommended thickness for the pumping design pressure should not be used.

- (d) All pipeline segments should be clearly identified with a permanently fixed unique identification mark or number, prior to being placed in service, showing the details required in accordance with *AS 1418.15 Cranes (including hoists and winches) – Concrete placing equipment*.
- (e) The pipe log book shall record wall thickness and pressure details, in accordance with *AS 1418.15 Cranes (including hoists and winches) – Concrete placing equipment*.

## **6. Safety equipment**

### **6.1 Provision of personal protective equipment (PPE)**

Personal protective equipment is the least effective method for controlling risk, however in many circumstances associated with the pumping of concrete this is the most practicable option. Before beginning any pumping operation, the concrete pump operator and the principal contractor or person in control of the workplace, should assess the conditions likely to affect the health and safety of workers and arrange for the provision and use of appropriate personal protective equipment.

The following items of PPE are required when pumping concrete:

- (a) safety helmets
- (b) eye protection
- (c) safety vest
- (d) rubber safety boots.

The following items of PPE may also be required when pumping concrete:

- (e) hearing protection
- (f) gloves.

### **6.2 Additional equipment**

Each pump unit should be equipped with the following items.

- (a) first aid kit (must include eye wash)
- (b) protective creams
- (c) fire extinguishers (as appropriate)
- (d) sufficient reflective traffic cones (minimum 450mm high), and
- (e) signs e.g. exclusion zone and use of high visibility vests.

## **7. Training and supervision**

The overall object of the Act is to prevent a person's death, injury or illness being caused by a workplace, by a relevant workplace area, by work activities, or by plant or substances for use at a workplace.

PCBUs have duties under the Act which include providing information, instruction, training and supervision to workers and others at a workplace. These duties ensure workers perform their work in a manner that is safe and without risk to health.

Information, training, and instruction should cover at least:

- (a) the work methods to be used in the setting up and safe operation of concrete placing booms and pumps
- (b) the method for inspection and maintenance of concrete pumping equipment
- (c) a knowledge of the manufacturer's operation and service manuals
- (d) the correct use, care and storage of personal protective equipment
- (e) the correct use, care and storage of tools and equipment to be used, including electrical safety practices, and
- (f) procedures to be adopted in the event of accident or injury.

Supervision must:

- (a) ensure that only those workers who have received training and instruction are authorised to carry out that work, and

- (b) include sufficient monitoring of the work to ensure that agreed safe work practices are being adhered to, including the use of all protection systems and personal protection equipment.

## Appendix 1: Dictionary

**Australian Standard** means a standard, rule, code or specification of the Standards Association of Australia.

**Clean out adaptor** means a short length of pipe with one end blanked off and connections for a water or air hose coupled to the pipeline for cleaning purposes. It should have a separate air relief valve vented to atmosphere and a pressure gauge when used with compressed air.

**Competent person** means a person who the concrete pumper ensures (prior to appointment), has current skills and knowledge through either training, qualification, or experience or a combination of those, who is industry based, and who may have obtained training certification from the appropriate manufacturer to have the knowledge and skill to enable that person to correctly perform the task required.

**Concrete pumper** means the PCBU of a concrete pumping business engaged by a principal contractor, subcontractor or person in control of a workplace to pump concrete.

**Concrete pumping pressure** means the pressure exerted by the pump on the concrete at the piston head.

**Condition of tipping** means a pump should be considered to be in the condition of tipping when the stability moment equals the overturning moment.

**Coupling system** means the connecting sections of a delivery pipeline.

**Delivery hose** means a flexible hose used in or at the end of the pipeline.

**Delivery pipeline** means a portable rigid or flexible piping system supplied in sections with the provision for joining together with a coupling system.

**Employee representative** means an employee, member of a health and safety committee or a person elected by the employees at a place of work to represent them on health and safety matters.

**Hose whip** means the uncontrolled and rapid motion of the flexible rubber hose on the end of a concrete placement boom or other concrete delivery line.

**Outriggers** means extendible structural members on the pump unit to increase the dimensions of the base to ensure the stability of the pump in set up, dismantling and use.

**PCBU** means person conducting a business or undertaking. See *Work Health and Safety Act 2011*.

**Placing boom** means a powered device to support and position a concrete delivery pipeline, which may incorporate folding, luffing, extending and/or slewing motions.

**Principal contractor.** See *Work Health and Safety Regulation 2011*.

**Professional engineer** means a person eligible for membership of the Institution of Engineers Australia or a Professional Engineer of Queensland.

**Pump unit** means the concrete pump, placing booms and associated equipment.

**Reducer** means a pipe that changes the internal diameter of the pipeline.

**Relevant workplace area** means:

- (a) any place, or a part of a place, used as a workplace, and
- (b) any area adjacent to the place or part associated with the use of the place or part as a workplace.

*Examples of areas that could be adjacent to a place or part and associated with its use as a workplace—*

1. shopping centre car park
2. common area in a shopping centre
3. hotel beer garden, and
4. outside play area for a child care centre.